

# VISHAKHA GUPTA

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## PERSONAL INFORMATION:

Research Interests : Operating systems, Virtualization, High Performance Computing and Embedded Systems (Subsuming embedded operating systems, distributed embedded systems, real time systems), Server interconnects, Non-volatile memory systems, Accelerated systems

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## EDUCATION

<b>Georgia Institute of Technology, Atlanta, GA</b> PhD Computer Science	GPA: 3.84/4.0	December, 2011
<b>Carnegie Mellon University, Pittsburgh, PA</b> MS Information Networking	GPA: 3.58/4.0	May, 2006
<b>Birla Institute of Technology and Science, Pilani, India</b> Bachelor of Engineering (Hons.) Computer Science	GPA: 3.81/4.0	June 2004

## PROFESSIONAL EXPERIENCE

- **Intel Labs, Hillsboro, USA – Research Scientist** (Systems and Software Research) September 2011-Present
  - Working on visual cloud infrastructure
  - Worked on graph analytics, storage and applications addressing upcoming non-volatile memory architectures
  - Worked on defining new server processor, memory and interconnect technologies
- **Intel Labs, Hillsboro, USA - Internship** (OS and VT Research Lab) June 2009 – Aug 2009; June 2010 – Aug 2010
  - Defined a new metric called kinship that extends the traditional notion of affinity to asymmetric multicore systems
  - Implemented a flexible and extendible kinship based model and a kinship based scheduler in hypervisor for handling performance as well as functional asymmetry in virtualized systems
- **HP Labs, Palo Alto, USA - Internship** (Exascale Computing Group) May 2008 – Aug 2008
  - Built a virtualization framework for accelerators that are off-chip and have closed access path to the hardware
  - Started working on a resource management infrastructure for accelerator based heterogeneous multicore systems (WIP)
- **IBM TJ Watson Research Center, Yorktown, USA - Internship** (Adv Operating Systems Group) May 2007 - Aug 2007
  - Implemented *Cellule* which is a prototype for lightweight execution of applications for the IBM Cell processors and presents a new and simpler software model for virtualization of Cell and other accelerators (*Work still ongoing*)
  - Ported IBM's research hypervisor (rHype) to Cell and implemented SPE library wrappers to run benchmarks like matrix multiplication, Black Scholes etc in a lightweight partition created by the Controller partition on rHype
- **Microsoft Corporation, Redmond, USA - Internship** (Mobile and Embedded Division) May 2005 - July 2005
  - Tested Tasks Smart phone feature parity with Pocket PC, added features to the Tasks area library and the overall application
  - Developed a power-toy to link Tasks with Outlook Calendar on smart phone and Pocket PC
- **Techlead Software Engineering Private Limited, Pune, India - Internship** January 2004 - June 2004  
Developed modules for Reflexis Workforce Scheduler, a workforce scheduling product for retail store chains
- **Bhabha Atomic Research Center, Mumbai, India - Internship** May 2001 - July 2001  
Developed software for Canny Edge Detection and establishing Correspondence of Features in Images

## PUBLICATION/PRESENTATIONS/PATENTS

- "Data Untangling Begins At Home". Invited Talk. WACI Session. ASPLOS, Atlanta USA. April 2016
- "Automated Memory Book Creation", Steven Bennett, Scott Robinson, Vishakha Gupta. *Patent #20130336543*. Issue date 2014-12-30
- "The workshop on diversity in systems research 2013", Christopher Stewart, Vishakha Gupta. *Operating Systems Review* 48(1): 103-106 (2014)
- "Slices: Provisioning Heterogeneous HPC Systems", Alexander Merritt, Naila Farooqui, Vishakha Gupta, et. al, In Proceedings of the Annual Conference on Extreme Science and Engineering Discovery Environment, Lightning talk, Atlanta, USA, July 2014
- "Improving Utilization and Application Performance in High-Performance GPGPU Clusters with GPGPU Assemblies", Alexander Merritt, Naila Farooqui, Vishakha Gupta, et. al. Supercomputing, Denver, CO - Poster. November 2013
- "Kinship: Resource Management for Performance and Functionally Asymmetric Platforms", Vishakha Gupta, Rob Knauerhase, Paul Brett, Karsten Schwan, In Proceedings of the ACM International Conference on Computing Frontiers, Ischia, Italy, May 2013
- "Benchmarking Next Generation Hardware Platforms: An Experimental Approach", Vishakha Gupta, Adit Ranadive, Ada Gavrilovska, Karsten Schwan. 3rd Workshop on SoCs, Heterogeneous Architectures and Workloads (SHAW-3), co-located with HPCA, New Orleans, USA. February 2012
- "Heterogeneous or not: Why Should Software Care?", Vishakha Gupta, Rob Knauerhase. Provocative ideas session. ASPLOS 2012
- "Pegasus: Coordinated Scheduling for Virtualized Accelerator-based Systems", Vishakha Gupta, Karsten Schwan, Niraj Tolia, et. al., In Proceedings of the *2011 Usenix Annual Technical Conference*, Portland, USA, June 2011
- "From Pegasus to Montage: Scheduling Multiple Personalities of Virtual Machines on Heterogeneous Multi-core Systems", Vishakha Gupta, Karsten Schwan. *USENIX Annual Technical Conference*, Portland, OR - Poster. June 2011

- "Shadowfax: Dynamically Composed GPGPU Assemblies", Alexander Merritt, Vishakha Gupta, Abhishek Verma, Ada Gavrilovska, Karsten Schwan, *5<sup>th</sup> Workshop on Virtualization Technologies in Distributed Computing (VTDC), in conjunction with HPDC 2011*, San Jose, USA, June 2011
- "Managing Virtualized Accelerators Using Admission Control, Load Balancing and Scheduling". Vishakha Gupta, Niraj Tolia, Vanish Talwar, Partha Ranganathan. *Patent #20110010721*. Issue date 2011-01-13
- "Attaining System Performance Points: Revisiting the End-to-End Argument in System Design for Heterogeneous Many-core Systems", Vishakha Gupta, Rob Knauerhase, Karsten Schwan, Sigops Operating Systems Review, Jan 2011(to appear)
- "GViM: GPU-accelerated Virtual Machines", Vishakha Gupta, Ada Gavrilovska, Karsten Schwan, Harshvardhan Kharche, Niraj Tolia et. al., *3rd Workshop on System-level Virtualization for High Performance Computing (HPCVirt), in conjunction with EuroSys 2009*, Nuremberg, Germany, Mar. 2009
- "Cellule: Lightweight Execution Environment for Accelerator-based Systems", Vishakha Gupta, Jimi Xenidis, Priyanka Tembey, Karsten Schwan, Ada Gavrilovska, CERCS Tech Report, Apr. 2010
- "High Performance Hypervisor Architectures: Virtualization in HPC Systems", A. Gavrilovska, S. Kumar, H. Raj, K. Schwan, V. Gupta et. al., *1st Workshop on System-level Virtualization for High Performance Computing (HPCVirt), in conjunction with EuroSys 2007*, Lisbon, Portugal, Mar. 2007
- "Virtualizing Heterogeneous Many-core Platforms", Greg Diamos, Ada Gavrilovska, Vishakha Gupta, Sanjay Kumar, Himanshu Raj, Karsten Schwan, Sudhakar Yalamanchili, *EuroSys 2007 Poster*, Lisbon, Portugal, Mar. 2007
- "Execution Environment Support for Many-Core Heterogeneous Accelerator Platforms", Vishakha Gupta, Sudhakar Yalamanchili, Jose Duato. CERCS Tech Report, Apr 2010
- "Wireless Ad-hoc Lattice Computer (WAdL)", Vishakha Gupta, Gaurav Mathur, Anil Shende, *Journal of Parallel and Distributed Computing*. Volume 66. Issue 4. April 2006. pp 531-541
- "Wireless Ad-hoc Lattice Computer (WAdL) for Analogical Simulation of Physical Phenomena". Vishakha Gupta, Gaurav Mathur, Anil Shende, Student Research Contest, *CCSCSE*. Nov 5, 04, Spartanburg, SC. This paper won the **first prize**.
- "Lattice formation in a WAdL (Wireless Ad-hoc Lattice Computer)". Vishakha Gupta, Gaurav Mathur, Anil M. Shende, *AlgorithmS for Wireless and Mobile Networks (ASWAN)*, Aug 26, 2004, Boston

## ACADEMIC HONORS

- BITS Alumni 30 under 30, 2012
- Selected to present my ongoing doctoral research at the **Grace Hopper PhD Forum**, September 2010
- Recipient of the **Intel PhD Fellowship** award for the academic year 2009-2010
- Recipient of **Verizon Fellowship** for outstanding performance as an MSIN student at the Information Networking Institute, CMU
- Recipient of **CMU Merit** Scholarship and **BITS Merit** Fellowship
- Recipient of **SOSP 07, SOSP 09** Travel Scholarship
- Awarded scholarships by Govt. of Maharashtra, India and Dhirubhai Ambani Foundation for standing 1st among over 1.3 million students in 10th grade and standing 2nd among 1.2 million students in 12th grade

## PROFESSIONAL SERVICES

- General chair for VEE 2016
- Program Committee member for VEE 2015 and SYSTOR 2015
- Co-chair, Diversity workshop co-located with SOSP 2013
- Reviewed papers for conferences and workshops (external) like LCPC 2014, HiPC, PPAM, MGC, USENIX ATC 2012, IEEE TPDS 2012, Intel internal
- Student representative on the Faculty Recruitment Committee and the PhD Governance Committee 2010-2011
- Administrator for Georgia Tech's version of Emulab - Netlab for 2008-09, co-admin 09-10.

## RESEARCH EXPERIENCE

### Coordinated System Level Resource Management for Heterogeneous Many-core Platforms

#### PhD Thesis, Advisor: Prof. Karsten Schwan

- Restructure hypervisor and system functions to create high performance environments with flexibility of execution and data sharing on heterogeneous platforms
- Design and develop scheduling and other resource management support for diverse platform resources
- Build policy support at hypervisor level to permit efficient resource usage and sharing

### Infrastructure for Area Driven Pervasive Computing Applications

#### Master's Thesis, Advisor: Prof. Peter Steenkiste

- Developed an infrastructure for area-driven applications enabling them to specify area-based user tracking requirements.
- The implementation utilized existing infrastructure of wireless access points to determine the area where a user is.

### A Novel Architecture for Distributed Computing (Wireless Ad Hoc Lattice Computer – ref: publication section above)

- Designed and simulated a computer architecture that utilizes mobile nodes to form a lattice computer
- Presented during the final round of *Intel India Student Research Contest* (2003-2004)

## PROJECT SUMMARY

### A Functional Network Simulator for IBM Cell based Multiprocessor Systems

- Designed a multi-cell network simulator utilizing IBM's Mambo simulator for a single Cell system
- Programmers can seamlessly utilize the multi-Cell simulator for developing and testing parallel applications.

### MyOS – A Real Time Operating System

- Designed and implemented a real time operating system using a Rate Monotonic Scheduling Policy and the principle of Highest Locker Priority for synchronization constructs on an XScale processor.

#### **Implementation of a (Unix-like) Kernel**

- Wrote a pre-emptive kernel for x86 platform with memory management, synchronization and kernel thread support
- Implemented fork(), exec(), exit(), wait(), sleep(), yield(), new\_pages(), remove\_pages(), deschedule() and other system calls
- Implemented handlers for keyboard, timer and various other exceptions like general protection fault, page fault etc.

#### **User Level Thread Library**

- Implemented user level thread primitives such as thread creation, destruction and join for kernel & user level threads
- Implemented synchronization constructs such as mutexes, condition variables, semaphores and reader-writer locks
- Implemented scheduling policies from uniprocessor round robin to a multi-processor scheme (for an m:n thread library)

#### **Distributed Embedded System Simulating an Elevator**

- Implemented a fault tolerant distributed elevator running on a simulator with emphasis on performance, efficiency and fairness. Software engineering design and principles occupied a major part of the development process.
- Adjudged *the best performing elevator in class* on all kinds of workloads tested by the instructor.

#### **CruiseControl - Optimal Routing on Roads using Dynamic Traffic Balancing**

- Enabled users to find the shortest or least congested route to reach their destination and the most convenient meeting spot.
- Implemented the core route computation servers and load balancing among these servers
- Selected for the Unites States final round of *Imagine Cup 2005* conducted by Microsoft Corporation

### **TEACHING EXPERIENCE**

- **Carnegie Mellon University, Pittsburgh - Teaching Assistant** (for Prof. Greg Ganger and Dr. Tina Wong) Jan 2006 – May 2006  
Project mentor for three teams taking **18-842: Distributed Systems**
- **Carnegie Mellon University, Pittsburgh - Teaching Assistant** (for Prof. Rajeev Gandhi) August 2005 – December 2005  
Designed lab assignment, conducted demos, evaluated components and delivered lectures for **18-342: Embedded Systems**
- **Carnegie Mellon University, Pittsburgh - Teaching Assistant** (for Prof. Peter Steenkiste) August 2004 – December 2004  
Designed lab assignment, provided help and delivered lectures for **18-544: Network Design and Evaluation**

### **GRADUATE COURSES:**

**Systems:** High Perf. Comp Architecture, Compiler Design, Adv Operating Systems, Operating Systems, Distributed Systems, Embedded Systems, Distributed Embedded Systems, Parallel and Distributed Computer Architecture, Design & Analysis of Algorithms, Adv Database Systems

**Networking:** High Performance Communication, Wireless Networking, Packet Switching & Data Networks, Computer Security

**Management:** Managerial Economics, Business Management, Principles of Management, Information Systems Modeling

**Others:** Computer Animation, Image Processing, Artificial Intelligence

### **SKILLS**

**Languages** : C, C++, JAVA, C#, Verilog HDL, LISP, SQL, JSP, HTML, ASP.NET, R

**Architectures** : 8085, 80x86, ARM7TDMI, Cell and MIPS

**Platforms** : Xen, UNIX, Linux, MS DOS, WINDOWS, rHype

**Software Packages** : VS.NET, Visual Age for Java, ORACLE-9I, Network Simulator (ns2), OPNET, CodeWarrior, Rational Rose